Observations on Litter Fall and Foliage Nutrient Content of Some Pacific Northwest Tree Species

Much research on the contribution of plant residues to soil fertility has been done in European countries and in the eastern United States. Little is known, however, about the quantity and quality of the litter fall of trees of the Pacific Northwest. Some preliminary observations are presented here concerning the annual litter fall of ten major tree species of the Pacific Northwest, both as to quantity of material returned to the soil and of the nutrient supply contained in that material.

In pure, well-stocked stands of each species, needle or leaf samples were taken together with samples of the soil humus layer and of mineral soil at 0 to 2 inches and 8 to 10 inches depth. The needle and leaf samples were analyzed for their content of nitrogen, phosphorus, potassium, calcium, and magnesium. Soil reaction or pH was determined for the humus layers and the soil samples.

Besides the analytical work, measurements of the annual fall of litter of each species were made by spacing 4-foot-square leaf traps beneath the stands. The total amount of litter collected over the course of one year was oven dried and weighed and the resulting figure was then converted to the oven dry weight of litter per acre that is deposited annually by such a stand.

Several factors must be taken into consideration in the interpretation of the annual litter fall and the nutrient contents (Table 1). It is known that the nutrient content of forest tree leaves varies during the growing season; that the leaf composition is influenced greatly by environment, especially the soil; and that the amount of litter fall varies markedly from year to year. In light of these variables, this evaluation of the seasonal contribution of plant nutrients through litter fall must be regarded only as a broad estimate. In the absence of periodic, long-time sampling, however, the data are still of interest as a general comparison between species, and they serve as a beginning toward determining the relative fertilizing effect of the litter of major Pacific Northwest tree species.

The extremely high nitrogen value found for red alder is of interest since the root nodules found on this species are reputed to fix nitrogen symbiotically, and the possible value of alder as a soil conditioner is suggested.

Phosphorus values were relatively low for all species, as has been found true in other foliage nutrient investigations. Low phosphorus values are characteristic of the highly acid Pacific Northwest soils, in which much of the natural phosphorus is tied up in relatively insoluble iron and aluminum compounds.

The only two broadleaved tree species included in this study, bigleaf maple and red alder, contained very high amounts of potassium as compared to the conifers. This difference has been found in other areas, although Lutz and Chandler[1] indicate that broadleaved species also contain higher amounts of magnesium and

[1]Lutz, Harold J. and Robert F. Chandler. Forest soils. 514 pp. N. Y. Wiley, 1946.

TABLE 1.—LITTER FALL AND FOLIAGE ANALYSIS FOR TEN PACIFIC NORTHWEST TREE SPECIES

Species	Annual litter fall, oven-dry weight	Foliage nutrient content					Total weight of nutrients	Soil pH		
		N	P	K	Ca	Mg		Ao Horizon	0-2 in. Depth	8-10 in. Depth
	Pounds per acre									
Western redcedar	1,914	11.9	1.7	6.9	42.8	0.8	64.1	4.20	4.51	5.26
Douglas-fir, 350-year-old	1,770	15.2	2.7	2.7	16.6	0.5	37.7	3.99	4.92	5.07
Pacific silver fir	1,582	19.8	1.9	3.8	14.5	0.9	40.9	3.77	4.35	5.02
Bigleaf maple	1,319	15.1	1.6	14.9	21.4	0.2	53.2	5.55	5.54	5.15
Western white pine	1,205	9.2	1.4	3.6	7.5	1.0	22.7	3.87	4.46	5.02
Red alder	1,172	27.6	1.5	11.6	9.6	0.1	50.4	4.22	4.10	4.20
Western hemlock	936	7.2	1.0	1.8	5.6	0.6	16.2	4.15	4.30	5.10
Douglas-fir, 100-year-old	822	7.0	0.7	1.7	8.0	0.2	17.6	4.85	5.05	5.50
Sitka spruce	804	9.3	0.8	1.9	3.9	0.7	16.6	4.14	4.20	4.47
Ponderosa pine, 100-year-old	718	5.6	0.7	3.2	2.7	0.6	12.8	4.20	5.95	5.50
Ponderosa pine, 350-year-old	548	2.8	0.4	1.9	2.3	0.4	7.8	4.06	6.13	6.15
Lodgepole pine	255	2.5	0.2	1.1	1.4	0.2	5.4	4.92	6.03	6.23

phosphorus, which is not indicated by these figures.

Western redcedar and bigleaf maple foliage were the only two samples which contained more than 1 percent calcium. Redcedar contained twice the amount of calcium as bigleaf maple and thirty times that of lodgepole pine, which had the lowest amount. In general, it might be said that western redcedar resembles eastern *Thuja* in calcium content, while bigleaf maple appears to be within the range of eastern sugar maple. Hemlock, white pine, and silver fir are not greatly different in calcium content from their eastern counterparts.

Ponderosa and lodgepole pine foliage both were well at the bottom of the list for nutrient content and for total annual fall of litter. Western white pine foliage had a generally higher nutrient content than did ponderosa and lodgepole, which is in keeping with its characteristic of growing on somewhat better sites than the other two pines.

Soil reaction did not follow closely the content of calcium in the foliage of the trees. Many other factors which combine to influence soil reaction mask the relationship between calcium and pH when only this limited number of samples is considered.

The findings emphasize the soil-building value of western redcedar and red alder in western forests and should be of use in the control of species composition in reforestation programs.

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